Proximal femoral replacement prosthesis for salvage of failed hip arthroplasty

Complications in a 2–11 year follow-up study in 19 elderly patients

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We reviewed 19 elderly patients who underwent revision total hip arthroplasty with a proximal femoral replacement prosthesis for aseptic loosening and severe proximal femoral bone loss. The mean interval from initial hip replacement to revision arthroplasty was 8 (2–20) years. The mean age of the patients was 78 (63–87) years.

2 patients died within 2 years postoperatively and 1 patient was lost for follow-up evaluation. The remaining 16 patients were assessed clinically and radiographically after a mean follow-up period of 5 (2–11) years. All patients had local pain relief, but they all needed a crutch or another walking aid. According to the Merle d'Aubigné hip-rating scale there were no excellent results, 1 very good, 8 good, 5 fair, 2 poor and no bad results.

4 patients had an intraoperative fracture, 7 had a dislocation, 2 had a deep infection, and 3 patients had progressive loosening of the screws fixing the greater trochanter to the femoral component.

Our series demonstrates that revision of a failed hip prosthesis, using a proximal femoral replacement prosthesis, presents complex problems.

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We report our experience with a cemented proximal femoral replacement prosthesis used for hip salvage in 19 elderly patients. All patients had a loose femoral component associated with severe proximal femoral bone loss.

Patients and methods

19 patients underwent revision total hip arthroplasty with a proximal femoral replacement prosthesis. There were 13 women and 6 men with a mean age of 78 (63–87) years. All patients had substantial proximal femoral bone loss that precluded the use of conventional long-stem femoral components. The indications for primary prosthetic hip replacement were primary arthrosis (11), displaced intracapsular fracture (6), posttraumatic arthrosis (1) and congenital dysplasia (1). The number of previous hip operations on the side of the revisions ranged from 1 to 6. The mean interval from the primary hip replacement to the index operation was 8 years, with a range from 2 to 20 years.

Technique of operation

The hip was exposed through a posterolateral approach with osteotomy of the greater trochanter, preserving the continuity of the abductor apparatus, as described by Mercati et al. (1972). The greater trochanter was osteotomized coronally along a plane that left the insertions of the gluteus medius proximally and of the vastus lateralis distally attached to the greater trochanter. The abductor apparatus was then reflected anteriorly, exposing the pseudocapsule, the residual proximal femur and the proximal part of the loose femoral component. The pseudocapsule was opened, the loose femoral component, cement fragments and detritus were removed. The femoral diaphysis was sectioned transversely at the level of intact cortical bone. The residual proximal femur was split longitudinally. As much soft tissue as possible was left attached to this residual bone so that it would serve as a vascularized bone graft. The femoral diaphysis was then prepared, using the intramedullary reamers provided by the manufacturer. After insertion of a Seidel plug (Howmedica, Rutherford, New Jersey, U.S.A.) the medullary canal was rinsed with saline solution. Bone cement (Palacos® with gentamicin, Schering Corporation, U.S.A.) was injected under pressure and the femoral prosthetic component was inserted. In all patients, a large stainless-steel proximal femoral replacement component

Table 1. 19 patients with proximal femoral replacement prosthesis for salvage of failed hip prosthesis

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	F	2	R	78	1	81	10	–	115	90	1700	+	–	–	25	–	–	72	5	5	4	14	F	–	+
2	F	1	L	75	1	82	14	+	365	330	3380	+	–	–	66	+	–	a							
3	F	2	L	80	1	83	15	+	180	140	900	–	–	–	21	+	–	86	5	6	3	14	F	+	+
4	M	1	R	59	3	67	17	–	235	200	1920	–	–	–	17	–	–	24	5	6	4	15	F	+	+
5	F	2	R	61	2	74	11	–	270	240	1000	–	–	–	31	–	+	82	6	6	4	16	G	+	+
6	F	1	R	66	1	81	13	+	225	210	2600	+	–	+	54	+	–	55	6	6	4	16	G	–	+
7	F	1	L	69	1	80	14	–	190	135	1000	–	–	–	19	+	–	40	6	6	5	17	V	+	+
8	F	2	R	85	1	88	10	–	125	55	700	+	–	–	29	–	–	b							
9	M	2	R	69	2	78	12	–	190	145	2500	–	–	–	25	–	–	86	6	6	4	16	G	+	+
10	F	1	R	70	1	85	10	+	285	240	3050	–	–	–	74	+	–	28	6	5	4	15	F	+	+
11	M	1	R	71	1	79	18	–	145	95	900	–	–	–	19	–	–	46	6	6	4	16	G	+	+
12	M	3	L	51	2	63	14	+	315	280	1600	–	–	–	61	+	–	132	6	5	3	14	F	+	+
13	F	1	R	68	2	82	20	–	85	50	1350	+	–	–	29	–	+	c							
14	F	2	L	60	1	70	14	+	220	195	2800	–	–	–	26	–	–	78	6	6	4	16	G	–	+
15	M	1	R	71	1	79	11	+	250	190	3300	+	–	+	126	–	–	49	5	6	4	15	G	+	+
16	F	4	R	55	6	68	9	+	240	210	1500	–	–	–	33	–	–	56	6	6	4	16	G	+	+
17	M	1	R	63	1	80	12	+	215	190	1800	–	+	–	45	+	–	36	5	5	2	12	P	+	+
18	F	1	L	67	1	87	8	+	165	135	2400	–	+	–	30	–	–	29	6	4	1	11	P	+	+
19	F	1	R	68	1	72	11	+	235	200	1000	–	–	–	22	–	–	24	5	5	5	15	G	+	+

A Case
B Sex
  M male
  F female
C Primary disease
  1 primary arthrosis
  2 displaced intracapsular fracture
  3 posttraumatic arthrosis
  4 congenital dysplasia
D Side of hip replacement
E Age at first hip replacement (years)
F Number of previous operations before segmental femoral replacement
G Age at time of segmental femoral replacement (years)
H Length of extramedullary part of femoral component (cm)
I Revision of acetabular component
J Duration of anesthesia (minutes)
K Duration of operation (minutes)
L. Amount of operative blood loss (mL)
M Urinary tract infection
N Postoperative pressure sores
O Postoperative pneumonia
P Duration of hospital stay (days)
Q Dislocation
R Deep infection
S Follow-up time (months)
  a lost to follow-up
  b died at 4 months
  c died at 2 months
T Pain score at follow-up (Merle d'Aubigné)
U Range of motion score at follow-up (Merle d'Aubigné)
V Gait score at follow-up (Merle d'Aubigné)
W Total score at follow-up (Merle d'Aubigné)
X Overall result at follow-up
  E excellent
  V very good
  G good
  F fair
  P poor
  B bad
Y Bone formation
Z Bone remodeling

(Protek A.G., Berne, Switzerland) was used, available in 13 extramedullary lengths ranging from 60 to 180 mm, with a straight intramedullary part of 140 mm in length and 13 mm in diameter and with a 32 mm head (Schneider 1982). The acetabular component was exchanged in 11 cases. Acetabular reconstruction was performed using morsellized allografts and solid allografts for segmental defects in all cases. In 1 patient, a cementless self-tapping hemispherical threaded socket (Mecring®, Mecron, Berlin, Germany) was used; in 6 patients a Müller reinforcement ring (Protek A.G., Berne, Switzerland) and in 2 patients a Burch-Schneider reinforcement ring (Protek A.G.) was used. The polyethylene cup was fixed to the reinforcement ring with cement.

The preserved part of the greater trochanter was fixed to the femoral component by a polyacetal washer and one or two screws.

The patients were allowed to walk with the aid of a walker after a mean of 5 days and gradually progressed to crutches or a cane. They were taught to walk without attempting to restrict the weight put on the involved limb.

Assessment of results

The files of all 19 patients were reviewed. 2 patients died within 2 years and 1 was lost to follow-up. The remaining 16 patients were assessed clinically at 2 years postoperatively, and annually thereafter, according to the hip-rating scale of Merle d'Aubigné (1970). The duration of follow-up was a mean of 5 (2–11) years.

Radiographic results were obtained from standard anteroposterior and lateral views taken immediately postoperatively, at 3, 6 and 12 months postoperatively, and annually thereafter. The occurrence of new bone formation around the extramedullary part of the femoral component and the incidence of bone remodeling of the femoral diaphysis were evaluated.

Figure 1. This radiograph taken 8 months postoperatively documents one episode of recurrent posterior dislocation. Note that the intraoperative fracture of the femoral diaphysis caused by reaming and treated by screw fixation, is healed (case 12).

Figure 2. This radiograph taken 80 months postoperatively shows loosening of one of the screws fixing the greater trochanter to the femoral component. Cerclage wires were used to treat an intraoperative fracture of the femoral diaphysis (case 14).

Figure 3. This radiograph taken 43 months postoperatively shows septic loosening of both prosthetic components (case 5).

Results (Table 1)

The mean operating time was 3 (1–5.5) hours. The mean operative blood loss was 1.9 (0.7–3.4) L.

Function could be assessed in 16 patients after a follow-up period of at least 2 years; there were no excellent results, 1 very good, 8 good, 5 fair, 2 poor, and no bad results.

Pain. The mean score was 5.6 points (0.7 preoperatively).

Motion. The mean score was 5.6 points (2.7 preoperatively).

Gait. The mean score was 3.7 points (1.7 preoperatively). All patients had a Trendelenburg sign and all needed a walking aid of some kind. 2 patients, both with score 5, needed only 1 cane for long distances but all other patients had lower scores displaying severe gait problems, necessitating 1 or 2 crutches. Gait problems (score 3 or less) were made worse by degenerative changes in the opposite unoperated knee (1 case), stroke (1 case), congestive heart failure (1 case), and the effects of a deep infection (1 case), respectively.

Radiography

On the femoral side, formation of new bone around the extramedullary part of the prosthesis was observed in 13 of the 16 patients with a follow-up of at least 2 years (Figures 1 and 3). This bone formation appeared very early at the residual host bone that was used as a wrap-around vascularized bone graft. Diaphyseal bone remodeling of the femur was observed in all patients (Figures 1–3). The cortex decreased in density and in thickness and assumed a cancellous appearance.

There were no cases of subsidence of the prosthesis in the absence of infection. Postoperative fractures of the femoral diaphysis did not occur.

Complications

A fracture of the femoral diaphysis occurred in 4 cases, either during removal of cement or during preparation of the femoral diaphysis using the conical reamer. These longitudinal cracks were all recognized during surgery, and were managed either by internal fixation (Figure 1) or cerclage wiring (Figures 2 and 3), prior to the injection of the cement. In all patients, immediate stable fixation of the femoral component was achieved, allowing these patients to walk postoperatively without restricted weightbearing. The fractures did not interfere with the postoperative rehabilitation program and had no consequences for the long-term function of the patients. The time spent in hospital was not increased. All fractures healed uneventfully.

Posterior dislocation, the most frequent postoperative complication, occurred in 7 patients (Figure 1). Early postoperative dislocation (from 5 to 28 days postoperatively) occurred in 5 patients. 2 of them required operative treatment because of recurrent dislocations. At operation, additional stability could be obtained by advancement and reattachment of the greater trochanter and by firm closure of the fascia lata. Late dislocations occurred in 2 patients postoperatively (6 months and 7 years, respectively) and were managed by closed reduction.

Loosening of screws fixing the greater trochanter to the femoral component occurred in 3 patients (Figure 2). The screws were removed because of severe pain.

Deep infection occurred in 2 patients. In 1 patient the infection was due to Staphylococcus aureus and was treated by systemic antibiotics and debridement including complete capsulosynovectomy. There were no radiographic signs of loosening of either prosthetic component. At operation, they were judged to be securely fixed and were therefore not revised. At latest follow-up, 2 years after this operation, the infection was clinically healed, but the overall clinical result was rated as poor. In the other patient, there were radiographic signs of septic loosening of the femoral component: lytic foci of the cortex, increasing radiolucent lines at the cement-bone interface and a periosteal reaction (Figure 3). The prosthetic components and the bone cement were removed and gentamicin-polymethylmethacrylate beads were inserted. Intraoperative bacteriological samples showed Staphylococcus aureus and Escherichia coli. The wound healed uneventfully and after 3 weeks the beads were removed and a new revision procedure performed using prosthetic components similar to those removed 3 weeks earlier. Systemic antibiotics were continued for 6 months postoperatively. At latest follow-up, 2 years after this two-stage revision procedure, the infection was clinically healed and the clinical result was rated as good.

Isolated acetabular re-revision for aseptic loosening was undertaken in 1 case: the femoral component showed no radiographic signs of loosening and was judged to be securely fixed at operation and therefore was not revised. 2 years after this last revision procedure the overall score was rated as good.

Discussion

Revision total hip arthroplasty is a challenging procedure, especially if loosening of the femoral component is associated with severe proximal femoral bone loss. Treatment options include cortical strut grafting (Gross et al. 1993), an allograft-prosthetic composite (Chao and Sim 1992), an uncemented distally supported femoral prosthesis (Wagner 1989, 1993), or a cemented proximal femoral replacement prosthesis. Using the latter technique, Katzner et al. (1979), Bosquet et al. (1980), Wünderlich et al. (1980), Sim and Chao (1981), Zichner and Heipertz (1981), Katzner and Schvingt (1982), Schneider (1982), Johnsson et al. (1985), Jarde et al. (1988) and Ross et al. (1988) have shown that the majority of their patients obtained pain relief. Our findings confirm these results, as all our patients obtained significant local pain relief.

A Trendelenburg sign was observed in all our cases, as also in the studies by Johnsson et al. (1985) and by Katzner and Schvingt (1982). In contrast, Bosquet et al. (1980) found no Trendelenburg sign in 10 out of 13 patients. A Trendelenburg sign may be seen when a prosthesis with a short offset is used. A short offset produces medial displacement of the femoral shaft and of the greater trochanter, reducing the length of the abductor lever arm. The proximal femoral replacement prosthesis used in the current series has been referred to by its promotors as the Krückstockprothese (cane prosthesis) because of its S-shape. With this design, the point of fixation of the greater trochanter is transferred more laterally in relation to the prosthetic stem, thus increasing the length of the abductor lever arm. It had been hoped that this would reduce the incidence of limping and the number of patients with a Trendelenburg sign. However, this theoretical benefit was not supported either by our own clinical findings or by two of the previous studies (Katzner and Schvingt 1982, Johnson et al. 1985). Moreover, the latter two studies did not allow any conclusions concerning the superiority of one proximal femoral replacement prosthesis (megaprosthesis) design over the other with respect to the functional performance. The Trendelenburg sign may be the result of weakness of the abductor muscles, due to scarring following repeated revision procedures.

Bone formation around the extramedullary part of the femoral component is an interesting observation which was also reported by Haentjens et al. (1989). It may be caused by viable periosteum and preservation of vascularized bone fragments around the extramedullary part of the stem. Spongious transformation of the remaining femoral diaphyseal cortex has also been described by Zichner and Hovy (1983), Blunn and Wait (1990), Franzén et al. (1994) using similar devices. The mechanism remains unclear, but may be due to a change in loading pattern or to vascularization of the remaining bone as suggested by Blunn and Wait (1990).

A longitudinal crack in the femoral diaphysis does not necessarily impair hip function, provided the fragments are adequately fixed and immediate mechanical stability of the prosthetic component is achieved. In our series, all cracks healed, supporting Charnley's view (1972) that fracture healing is not impaired by the presence of polymethylmethacrylate covering the fracture site. Accordingly, the postoperative recovery was not significantly delayed.

Dislocation, the most frequent complication in our series, occurred in 7/19 cases. The causes of dislocation are multifactorial. All our patients had several risk factors, such as old age (Newington et al. 1990), a short offset of the prosthesis (Charnley 1979, Fackler and Poss 1980) and multiple surgery (Woo and Morrey 1982). The latter authors found a twofold increase in risk for dislocation in patients with previous surgery, and this could presumably be explained by abduction insufficiency and impaired healing of the scarred soft tissues.

In our series, precautions were taken during surgery to minimize the risk of postoperative dislocation. Particular attention was paid to the following technical points: positioning the acetabular component with a lateral opening of less than 30 degrees, as proposed by Katzner and Schvingt (1982); reattachment of the abduction apparatus, as proposed by Bosquet et al. (1980), Zichner and Heipertz (1981) and Johnsson et al. (1985); limb-lengthening by about 1 cm to improve joint stability, as recommended by Schneider (1982). Despite these precautions, the dislocation rate in our series was high. Close analysis of the literature on revision total hip arthroplasty with a cemented proximal femoral replacement prosthesis reveals that the postoperative dislocation rates vary widely. One reason may be the various postoperative regimens. Bosquet et al. (1980) immobilized their patients for a period of 12 weeks in a Thomas-Pearson suspension or in a plaster spica-cast, holding the leg in abduction and internal rotation, and reported no dislocation. Katzner et al. (1979) and Katzner and Schvingt (1982) imposed bedrest for a period of at least 2 weeks with an abduction pillow and an antirotational splint. They allowed protected weight-bearing with 2 crutches from the third week postoperatively. They reported posterior dislocations in 4/27 cases in 1979 and in 5/43 cases in 1982. Sim and Chao (1981) immobilized the limb in abduction in a balanced suspension splint for 7–10 days postoperatively and reported dislocation in 1/10 cases.

Malkani et al. (1993), who allow early protected weight-bearing, using crutches or a walker, reported dislocations in 8/36 cases. Ross et al. (1988) reported an early dislocation rate of 43%, an incidence which was subsequently reduced to 5% by abduction bracing on mobilization. As most of our patients were quite elderly, we preferred to mobilize them as early as possible. However, care was taken to avoid forced adduction or rotation of the operated hip. An abduction pillow was recommended during bedrest. Considering the high dislocation rate in our series, we now recommend a hip-abduction brace for at least 3 months. From the third month postoperatively, unlimited activities, as tolerated, are allowed.

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